

Raman Effect

Monochromatic IR rays of very short freq range are incident on a transparent medium (like solid liquid or gas) gets partially scattered.

1928 Raman Observed

Scattered rays had a spectrum

of: → Central Bright Line
→ Lines of lesser intensity on both side of central line.

* Central Line - freq same as incident
(Rayleigh scattering)

→ Lines on Left of
Central Line

↳ √ less than original

Stoke's Lines

→ Lines of Right of
Central Line

↳ √ higher than
original

↳ Anti-Stoke's Line

* Anti-Stoke's Line are
less intense than Stoke's
Line

* Central, Stoke's & Anti-Stokes
↳ Raman Lines

⇒ Presence of freq(s)
Shorter and larger
than incident freq in
the spectrum of scattered
light is called RAMAN
EFFECT

- * Incident freq - ν
- * Stokes Lines - ν_1 ($\nu_1 < \nu$)
- * Anti Stokes Lines - ν_2 ($\nu_2 > \nu$)

$$\nu - \nu_1 = \nu_2 - \nu = \Delta \nu$$

$\Delta \nu$ — does not depend on ν
Raman Shift
↳ Depends only on Scatterer

$$\Delta\nu \approx 10^{12} \text{ to } 10^{14} \text{ Hz}$$

\approx FIR - NIR Region
of EM Spectrum

\Rightarrow Energy involved in
Raman scattering
must be due to vib
+ rot energy states.

Characteristics of Raman Lines

- (1) Stoke's & Anti Stoke's Lines
are symmetric
- (2) Fundamental freq same as
Incident
- (3) Stokes - Shorter freq
Anti Stokes - Longer freq

(4) $I_{\text{Stokes}} > I_{\text{Anti Stokes}}$

(5) $\Delta\nu \approx \text{IR, NIR, FIR}$

(6) $\Delta\nu \rightarrow$ depends ONLY
on scatterer

(7) $\Delta\nu \propto \frac{1}{T}$

Difference Between Compton Effect & Raman Effect

Compton

(1) X-Rays & γ rays

(2) $\nu_{sc} < \nu_{in}$

(3) $\Delta\nu = f(\theta)$
only

(4) $\Delta\nu \neq \text{scatter}$

(5) Involve Electronic energy level

Raman

IR, FIR, NIK region

$\nu_{sc} = \nu_{in}$

$\nu_{sc} > \nu_{in}$

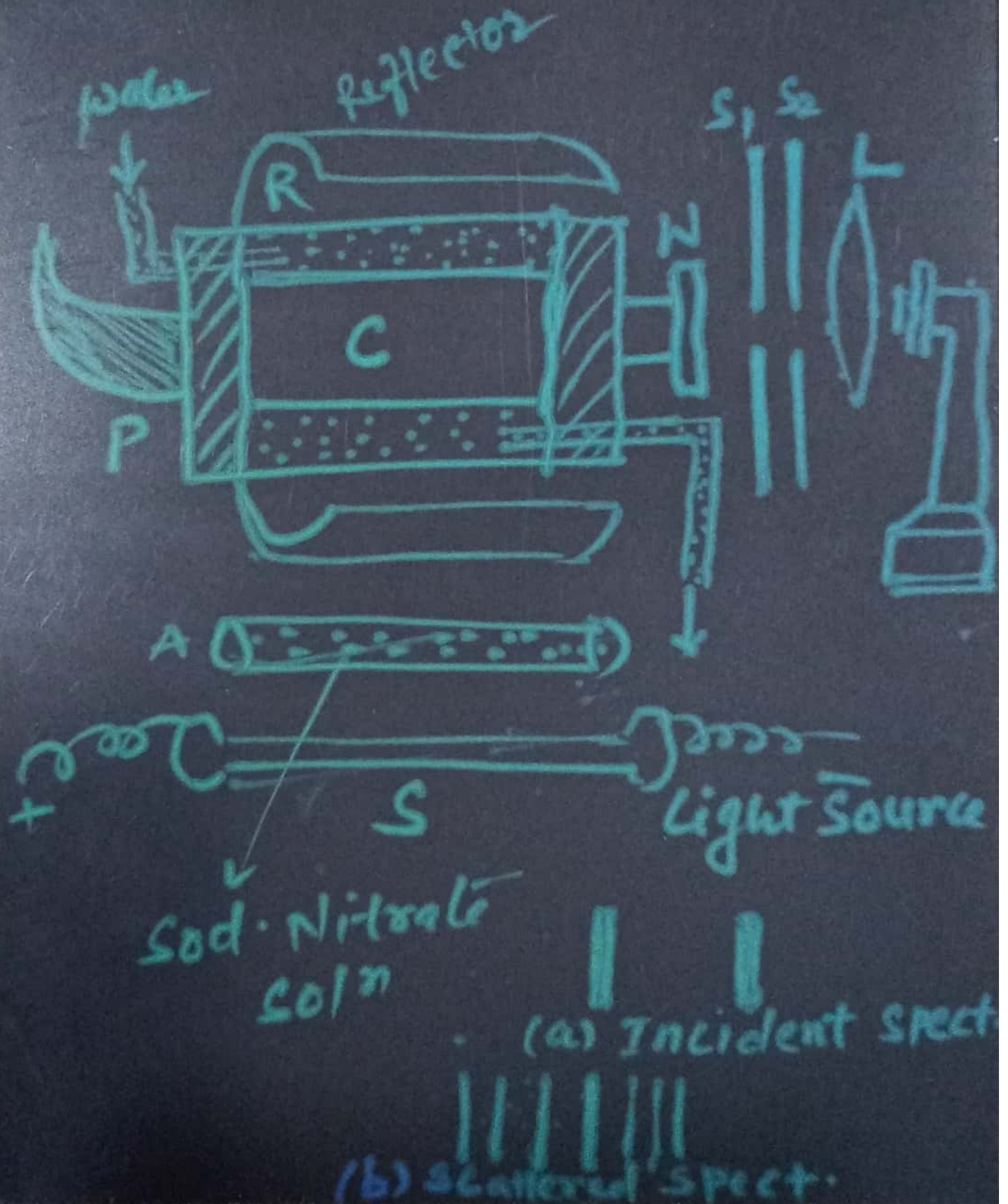
$\nu_{sc} < \nu_{in}$

$\Delta\nu \neq f(\theta)$

$\Delta\nu = f(\text{scatter})$

Results due to transition in vib, rot state

Experimental Arrangement for Raman Spectroscopy





(a) Incident spectrum



(b) Scattered spectrum